

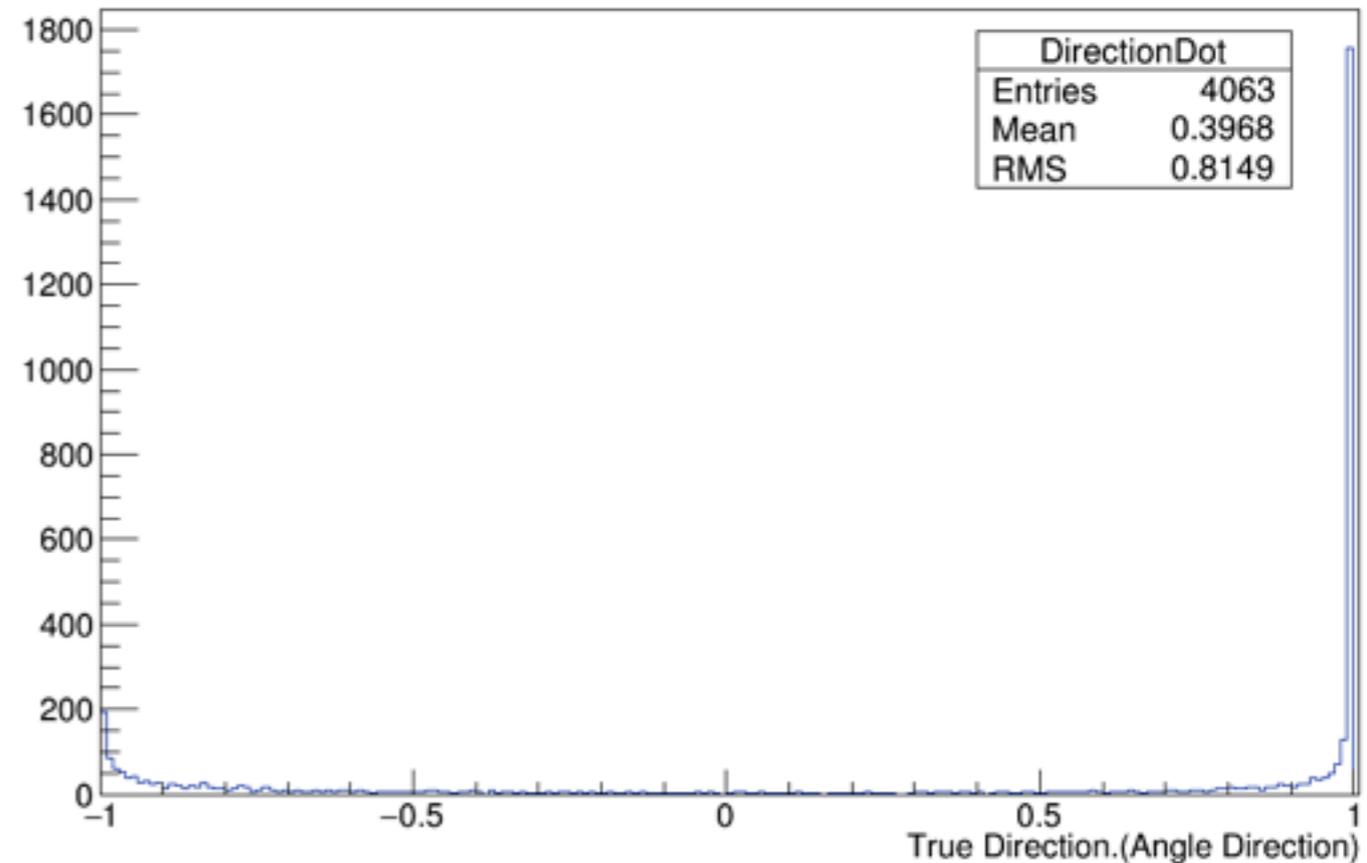
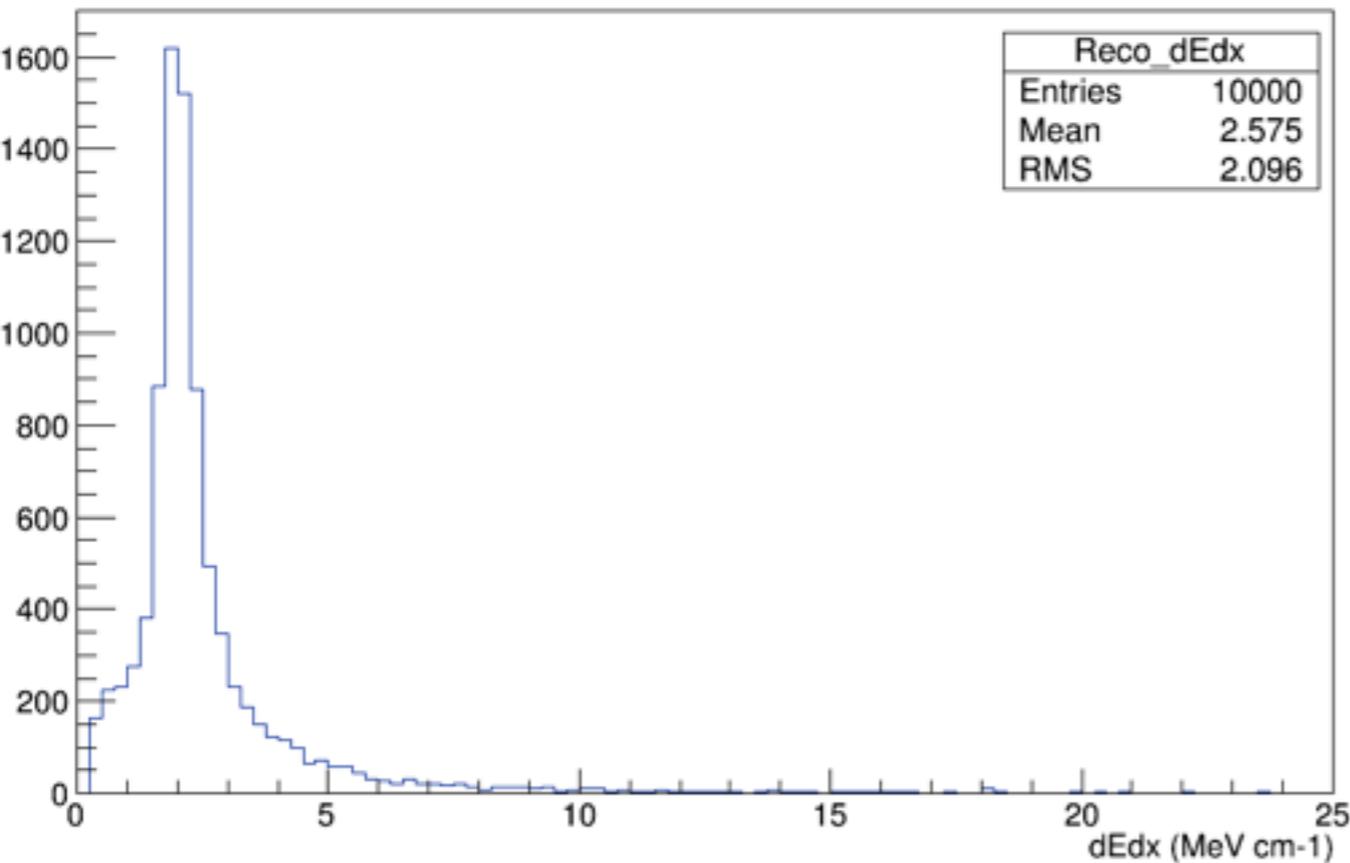
# Far Detector EM Shower Recon Update

Mike Wallbank  
University of Sheffield  
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# Recent Improvements

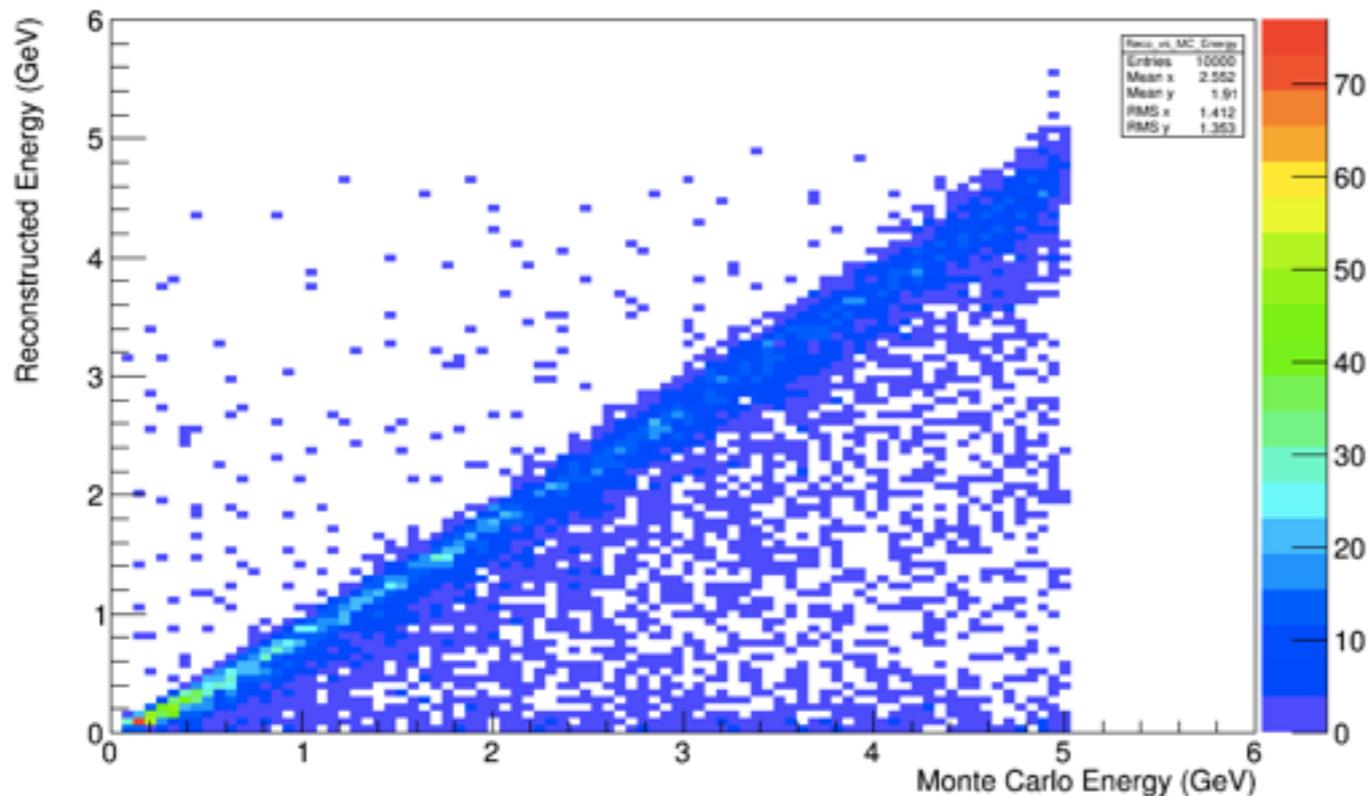
- I have been working hard on improving the showers made by EMShower since the last meeting.
- Improved the shower properties:
  - Fixed the issue which led to a lot of shower direction being exactly opposite.
  - Found the charge->energy conversion for the DUNE FD.
  - Modified  $dE/dx$  calculation to be more accurate.
- Also improved the track/shower separation algorithm to assist the reconstruction of neutrino events at the FD.

# Shower Properties



- FD electron sample.
- Left:  $dE/dx$ . Looks *much* better after the recent improvements.
- Right:  $\text{trueDirection}.\text{(reconDirection)}$ . Still looks excellent.

# Shower Energy



Energy looks ok in general.  
Low reconstructed shower energy now looks like the biggest problem for me to fix!

- Made the shower energy determination a separate algorithm (so Dorota can use it):
  - `RecoAlg/ShowerEnergyAlg.(cxx/h)`
- This uses a linear function to convert the total charge from all the hits in a given plane to energy.
  - Different for each plane.
  - Using MC particle gun (photons), determined this function for dune35t and dune10kt.
  - Implemented in `RecoAlg/showeralgorithms.fcl`

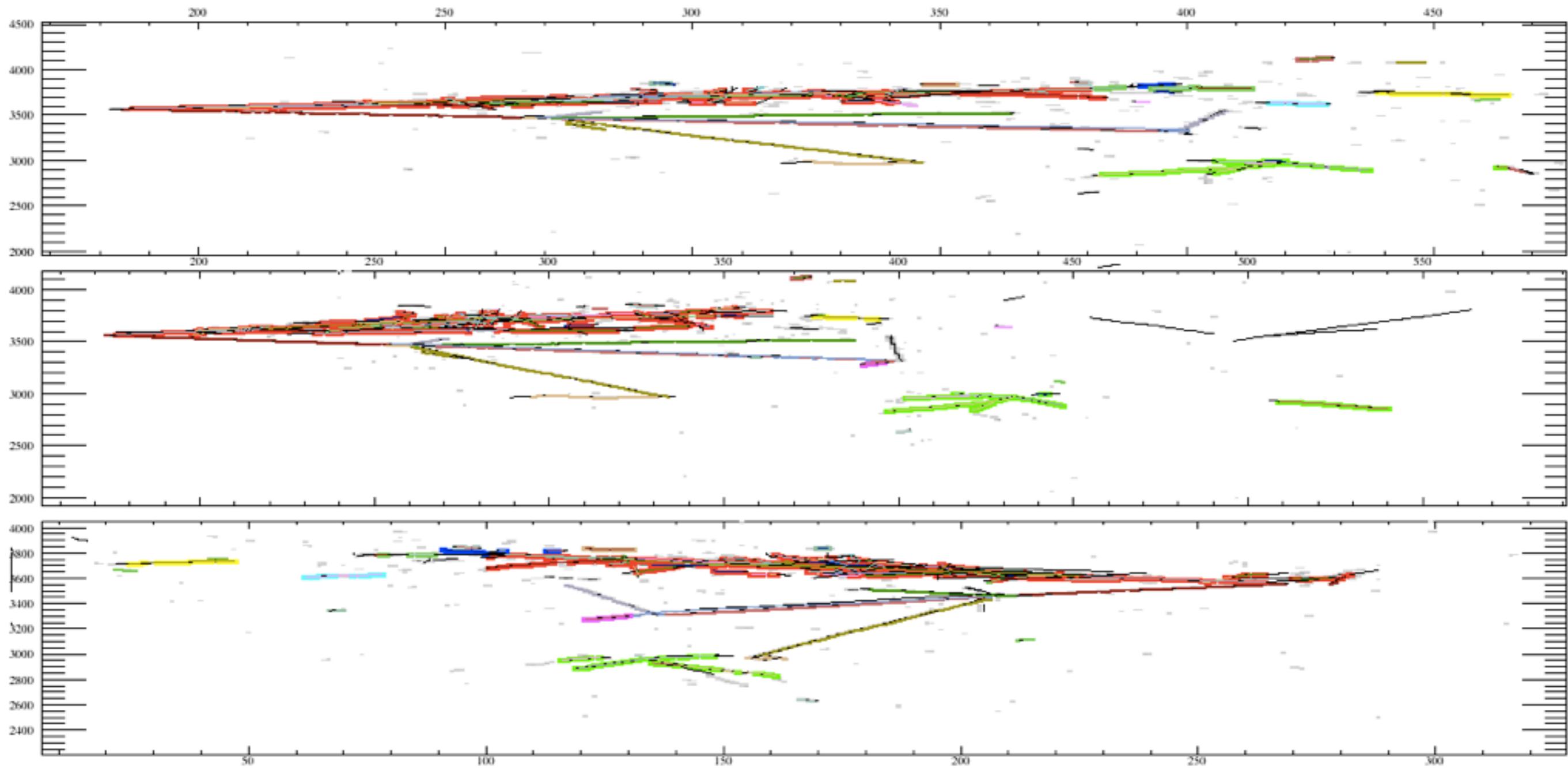
# Track Shower Separation

- Moved this to a separate algorithm
  - `RecoAlg/TrackShowerSeparationAlg.(cxx/h)`.
  - Configured in `RecoAlg/showeralgorithms.fcl`
- Still early on in its development;
  - Right now, we just want something which can be used to separate out a typical nueCC event (i.e. the electron reconstructed as a shower, any hadrons as tracks).
  - We have this, ready for the next MCC!
- Runs before any cluster/shower reconstruction to remove track-like objects.

# TrackShowerSeparationAlg

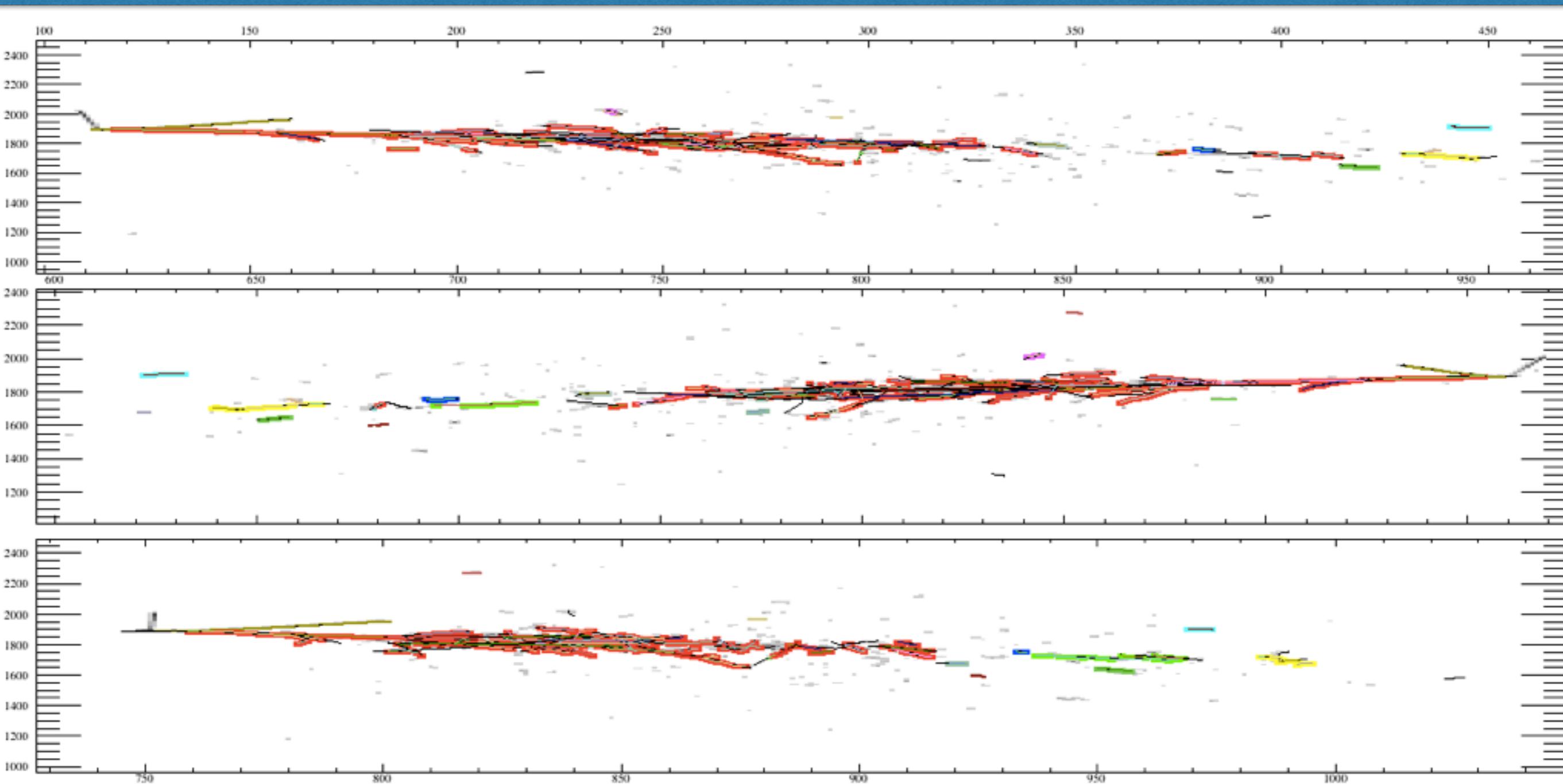
- The algorithm uses vertices previously reconstructed (by cluster crawler) and the output from the tracking.
- Looks at all tracks originating near the vertex and decides whether or not they are a track or shower; hits associated with track-like objects are removed.
- Runs recursively over all other tracks to remove any that are too close to previously determined tracks and are not shower-like.
- ‘Shower-like’ is determined by projecting a 3D cone out from the end of the track and determining how many space points lie within in, and their distribution.
- If no vertex, tracks are oriented towards the centre of the shower.

# Examples



FD nueCC (inc two low energy photons, a charged pion and a neutron)

# Examples



nueCC (with three protons)

# Summary

- Continuing to improve the showering provided by the EMShower module.
- Added the algs ShowerEnergyAlg and TrackShowerSeparationAlg to assist with the reconstruction.
- All ready for the MCC.
- This week, will start using these showers to identify pi0s in the 35t.